AQUA Infopaper

Everything you always wanted to know about recirculating systems

Different Systems

pH Stability

Problem Analysis

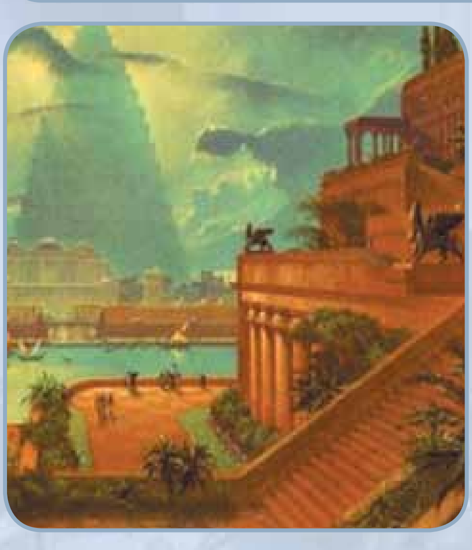
Cultivation Tips

CANNA

Thé solution for growth and bloom

Cultivation without potting mixes

Hydroponic cultivation systems are tremendously popular, and are likely to become even more so. Hydroponic systems are suitable for both small and large-scale use. Direct control options mean higher yields where correct nutrients are used. With the current sophistication of measuring equipment and technological advancements in the industry as a whole, the future appears bright. Hydroponic systems have even been developed to provide astronauts with fresh food during expeditions to Mars.



History

The word hydroponics comes from the Greek words hydro (water) and ponos (to work) and literally means 'water work'. The first hydroponic systems come from antiquity. In fact, The Hanging Gardens of Babylon, and the floating gardens of the Aztecs in Mexico were the first hydroponic systems. Thanks to the continuous flooding it was possible to cultivate food the whole year round.

The basis for modern hydroponic systems was laid after the experiments that took place from 1865-1895 done by German scientists Von Sachs and Knop. They discovered that plants needed certain nutritional elements to develop.

The first successful hydroponic systems were developed in the thirties by Dr. Gericke in the American state of California.

During the Second World War these systems were adapted to provide American soldiers with fresh vegetables. The first hydroponic systems were adapted for commercial purposes for the production of vegetables and flowers in the seventies and eighties.

Hydroponics is ...

A method of growing plants without potting mixes, in which all the nutrients are supplied through the water.

A distinction can be made between 'real' hydroponic systems in which plants are cultivated without using substrate (NFT, aeroponics) and hydroponic systems that use a substrate (rockwool, perlite, coco, clay pebbles and peat). The type of nutrient that must be used depends on the type of system. An important distinction can also be made between open and closed systems. In open cultivation systems (run to waste) substrate is continuously supplied with fresh nutrients, while the old is removed from the substrate by the drainage system. In a closed or re-circulating system the nutrients aren't removed by the drainage system, it is collected and supplied to the plants again. This is particularly useful if no substrate is being used in cultivation or if the substrate retains relatively little moisture (baked clay pebbles and perlite).

It is very important in hydroponic cultivation systems that the nutrient solution contains all the necessary elements that the plant needs in the correct proportions. The most suitable type of system depends on the grower's preference and experience.

Hydroponics, pro and cons

	Open system (run-to-waste)	Closed systems (recirculating)
Pro	Easier to control as the plant receives fresh made nutrient continuously. Also suitable for low quality tap water (EC of 0,75 or higher).	No systems drain necessary for used nutrients. Lots of air available for the roots when the proper substrate is used.
Cons	Higher loss of water and nutrients. Needs to be flushed away.	Diseases can spread trough the entire system by recirculating nutrients. pH and EC levels have to be monitored.
Nutrient	CANNA HYDRO	CANNA AQUA

CANNA
Thé solution for growth and bloom

Different systems

1 Nutrient Flow Technique

The first NFT (Nutrient Flow Technique) systems were introduced in the seventies. Allen Cooper developed the first NFT system in England. In NFT systems a series of tubes provide a constant, gentle flow of nutrient solution to the roots. The nutrient solution that drains from the root environment is gathered in a reservoir and then recirculated to the plants.

In recent times, the NFT tables have also become very popular for cultivation in this manner. This approach works on the same principle as the first tube system developed. To ensure that the nutrient solution has sufficient flow the tubing itself must have a fall of around 1%. In a tunnel construction the flow rate should be around 1litre per minute. Take care to ensure that the root mass at the bottom of the tunnel doesn't become too dense!

If this occurs there is the danger that the nutrient solution will flow over the outer layer of roots, so that there is not enough contact between the nutrient solution and the roots inside the root mass. Under these circumstances the plants will wilt more quickly and nutrient deficiencies may arise. In order to prevent such a thick root mass from developing it is advisable to make sure that the tubes are no more than 9 meters in length and that they have a diameter of at least 30cm.

An imminent nutrient deficiency in a NFT system can often first be seen on the plants at the end of the flow (the lowest plants). This is because the plants at the beginning and middle of the flow are still able to extract nutrition from the nutrient solution. By keeping an extra close eye on these plants, nutrient shortages can be spotted and corrected, sooner. Correction is achieved by increasing the flow rate and/or increasing the strength (EC) of the solution.
As well as nutrient deficiencies, oxygen shortages are often the first problems seen with the plants at the end of the flow. A shortage of oxygen causes the roots to turn brown with a corresponding drop in the plants uptake of water and nutrient. The chances of oxygen shortages arising are greatest during the fruitforming phase and in stressful situations. Using enzymes that stimulate root decomposition leads to fewer dead roots remaining and a more vibrant plant. Under normal circumstances there will always be a certain amount of dead root material in the system, but, so long as there are enough white, healthy roots, this is no reason for panic.

2 Aeroponics

Aeroponics was introduced in 1982, a few years after the NFT system; it originally comes from Israel. Aeroponics is a system in which misters are used to continuously bathe the roots in very fine droplets. The smaller the droplets are, the better is the contact between the nutrient solution and the roots, and the better is the uptake of food and water. Given that, practically speaking, the roots are growing in air; they always have sufficient oxygen available and large yields become possible. The biggest disadvantages off aeroponic systems are the relatively high initial investment costs and the systems' proneness to malfunction. Leaving a thin layer of water on the bottom of the misting room will ensure that plants don't go without water if there should be a system failure.

1

Copyright: Esoteric Hydroponics

2

Copyright: Esoteric Hydroponics

3

Copyright: Esoteric Hydroponics

4

Copyright: Esoteric Hydroponics

3 Ebb and flood systems

In an ebb and flood system, the plants are placed in a box that is periodically pumped full of nutrient solution. The substrate soaks up the nutrient solution, which is then pumped away. By filling the box with nutrient solution the old air is pushed out as the solution is pumped away and fresh air flows into the medium.

In order to prevent oxygen shortages from occurring around the roots, the medium must not be saturated for too long with water and it must contain sufficient air when the nutrient solution has drained away. One guideline for this is to ensure that the process of pumping full and then emptying should take no longer than 30 minutes. The recommended frequency for flooding depends on the substrate that is being used and each plant's root volume. CANNA Clay Pebbles retain little water and must be flooded more often than a system with rockwool, for example, which will hold more water.

4 Drip systems

Drip systems are perhaps the most common type of hydroponics systems in the world, owing to their simplicity. A clock controls a pump in the nutrient tank. When the clock switches on the pump and a small drip mechanism drips a nutrient solution over the base of each plant. The excess nutrient solution is caught in the nutrient reservoir for subsequent reuse, or drained away. In this system, the plants are kept in an inert substrate. Like with the ebb and flood system, the watering frequency is different.

In practice

Cultivation without potting mixes offers great advantages to the grower. The most important benefits are the high degree of control, more efficient water consumption and the lack of substrate waste (NFT). However, the drawback is that recirculating systems require more management. This stems from the fact that changes can occur rapidly in recirculating systems; the nutrient directly influences the crop and vice versa. Acting too late or incorrectly will have direct, rapid negative consequences.

Using recirculating systems

Compared with cultivating on substrates with high nutrient and water buffers, such as potting soil or coco, recirculating systems require closer monitoring of the nutrient and the plants. As the cultivation systems contain little to no nutrient buffer, changes to the nutrient solution have a direct impact.

The plants react to the nutrient solution incredibly fast; within a single day, a healthy looking plant can wilt due to a lack of water.
The plants and nutrient must therefore be observed and checked regularly. Naturally, proper nutrients are indispensable for achieving good results. The following factors are important to ensure proper nutrient in recirculating systems:

- Mineral composition of the nutrient
- Content of the nutrient reservoir
- Acidity of the nutrient (pH)
- Nutrient strength (EC)
- Temperature (water and air)
- Water quality

In Nimbin Australia, frogs live in the nutrient reservoir.

Nutrient strength (EC)

An EC-meter can measure the concentration of dissolved salts and can also measure the total volume of nutrient elements that are dissolved. In recirculating systems it is certainly not to be trusted 100%. This is because certain nutritional elements have built up in the nutrient solution, while at the same time others have become diluted.

It is advisable to start with an EC that is between 0.8 and 1.0 higher than the EC from the water supply and to gradually raise this as necessary to a maximum of 1.3-1.7 above the water supply's EC. Keeping a regular check on the nutrient solution's pH and EC levels and observing the plants is necessary to be able to take the correct action at the correct time. (If necessary), pH fluctuations between 5.2 and 6.2 are perfect. (See the graph 'pH development using AQUA nutrient')

Do not act too hastily!

Nutrient reservoir

The nutrient reservoir in recirculating systems must be checked regularly and topped up, or renewed, when necessary. This is necessary to prevent shortages and build-ups of salts. The frequency with which the solution has to be renewed depends on how intensive the cultivation process is and the size of the nutrient reservoir. The nutrient reservoir must contain at least 5 liters per plant. The more nutrient there is available for the plants, the smaller any fluctuations in the pH and EC will be. Under normal circumstances the nutrient should be renewed every 7 to 14 days. If the nutrient is not renewed in time, the desired balance between the different nutritional elements will be severely disrupted.

Nutritional elements such as calcium, magnesium, sulphate, sodium and chloride will build up first. This can happen without affecting the EC! The elements nitrogen and phosphate will be exhausted first, which can cause shortages. These are visible on the larger leaves, which can turn completely yellow (nitrogen shortage), or will show purple spots (phosphate shortage). Build-ups of sodium and chloride will slow down growth. The nutrient reservoir needs to be regularly topped up to its original level, in between the days on which the nutrient solution is renewed.

Start topping up when 25 to 50% of the nutrient solution has been used up. It is best to use a solution that is approximately half as strong as the original nutrient solution. In circumstances where evaporation is a concern, the reservoir is best topped up with tap water. This is the case when the temperature is high and humidity is low, for example. In this way, evaporation can take place easily while the nutrient solution's EC is prevented from rising.

Given the fact that the nutrient solution has to be renewed regularly, this is not, strictly speaking, a sealed system. Reverse osmotic filters can be used to remove build-ups of salts such as sodium and chloride, which will reduce the frequency with which the nutrient solution has to be renewed.

Acidity (pH)

Stable pH values

Stable pH values are important for optimizing the availability of nutrients for the plants. If we compare run to waste systems, with recirculating growing systems then we will see that the pH value in the latter fluctuates more and should therefore be supervised more carefully. This fluctuation occurs because waste products from the roots directly affect the nutrient solution's pH value. This influence is, among other things, dependent on the plants' stage of development, their condition, the nutrient solution's composition and the water supply. During the growing phase, plants tend to cause the nutrient solution's pH to rise. This happens because at this stage the roots can excrete relative large quantities of elements that increase the pH. During the flowering phase, the reverse happens: the roots now produce acidic secretions causing the nutrient solution's pH to fall. To a large extent, the nutrient solution's composition determines whether or not the roots excrete predominantly alkaline or acidic secretions. By using different nutrient solutions that are customized to the different phases of the crop (vegetative and generative), you ensure that the pH remains as stable as possible.

Trace elements

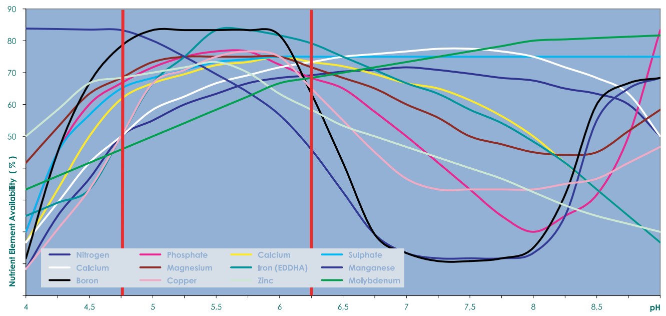
Trace elements present in the water also have an effect on the pH during cultivation. In hard water areas (high bicarbonate content) the nutrient solution's pH shows a tendency to rise after the solution has been prepared and the pH balanced. By balancing the nutrient solution with a lower pH value (5.2-5.3), more bicarbonate is neutralized and the pH shows less tendency towards rising. In soft water areas with low bicarbonate content (osmotic water) drops in the pH value are more likely to occur. This is because soft water has less pH buffering capacity than hard water and this is also the reason why in soft and osmotic water regions nutrient solutions must be prepared with a higher pH (5.8-6.2).

If the pH is too low, certain nutritional elements such as iron and manganese, as well as the toxic aluminium, are dissolved more easily, which can cause damage as a result of over nutrient availability. If the pH drops too low it is sensible to raise it by using a caustic product containing bicarbonate. In doing this, you not only increase the pH, but also the nutrient solution's pH buffer.

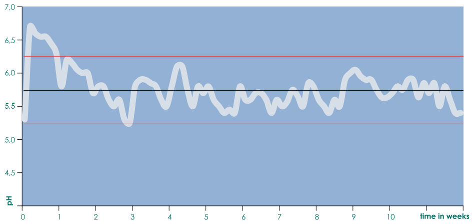
Influencing pH

Plants are capable of actively influencing the nutrient solution's pH. If the intake of food is disturbed when the plants suffer a pathogenic attack, for example mould, it can cause the nutrient solu-tion's pH to drop below 3. Another symptom can be noticed with iron deficiencies and, in this case, the pH is actively lowered to make iron more available to the plants. For this reason, it is not advisable to have the same value for the pH continuously. With a good nutrient solution and a pH between 5.2 and 6.2 there should be no nutrient problems. If the pH should be lower than 5.0 or higher than 6.4 for a few days, it is advisable to carry out manual adjustments or to change the composition of the nutrient.
If CANNA Aqua Vega is being used and the pH drops too low during the twelve-hour cycle, changing to CANNA Aqua Flores is recommended (Flores is less acid; it is important to note that the plant now receives nutrient that is the best possible for its bloom). If the pH is too low, increase with CANNA pH+ (Pro).

pH vs Nutrient element availability



pH fluctuation with AQUA



Self-regulating pH

pH stable

With CANNA AQUA, every effort is made to ensure that the pH in the nutrient solution remains as stable as possible without affecting the quality of the nutrient.

In tests that were carried out in which the daily pH and EC were measured and complete weekly nutrient analyses were made, it was shown that the pH fluctuated between 5.2 and 6.2 throughout the complete cultivation cycle, (with the exception of the first few days). **It wasn't necessary to correct the pH at all.**

CANNA
The solution for growth and bloom

Water quality

The water quality can make it very difficult to achieve good results with recirculating systems. High proportions of bicarbonate, sodium, chloride or heavy metals such as zinc, iron or manganese cause common problems stemming from the water quality. Tap water with a high EC (greater than 0.75) can mean high concentrations of sodium or chloride and may cause difficulties. Using a reversed osmosis filter can reduce high sodium and chloride content in the tap water.
Well water or water that is fed in via zinc pipes can contain too many heavy metals. Spring and surface water may contain organic contamination and residues of pesticides, which can have an adverse effect on the growth of the plants.

Composition

The proportions of the various nutrient elements are more important for recirculating systems then with any other system. This is because the plant directly influences the composition of the nutrient. Not all nutrients are absorbed with equal ease by the plant. Potassium (K), for example, is absorbed much more easily than calcium. In a recirculating nutrient solution, the potassium concentration will drop much faster while calcium might accumulate.

Another important aspect of the nutrient is the type of nitrogen. If nitrogen is offered in the form of nitrate, the absorption of potassium and calcium will be stimulated while at the same time the pH in the nutrient solution rises; if nitrogen is offered chiefly in the form of ammonium, the result will be the opposite. **The easiest way to avoid problems with nutrients is to use ready-made nutrients with a composition suited to cultivation on recirculating systems.**
CANNA has developed a special line of nutrients for this: CANNA AQUA.

Disease and plagues

The major advantage of hydroponics is that the inert substrates used are sterile, and so contain no diseases or weeds. However, this does not mean that no diseases ever occur. The absence of competing microorganisms means that any diseases and plagues that are introduced can develop much faster, and a pathogenic mould can infect all the plants via the circulating water.

To create a healthy microclimate in spite of this, useful micro-organisms can be administered to slow down diseases. Examples of positive micro-organisms include Bacillus Subtillus and Trichoderma Harazium. These micro-organisms can produce antibiotics and enzymes that halt the development of fungal diseases.

The fungal pathogens pythium and fusarium are generally the cause of the most common diseases in recirculating systems (for more information, see CANNA's info couriers on Fusarium and Pythium). Pythium is a type of mould fungus that penetrates the root and interferes with the absorption of water and nutrients. The roots start to swell and the tips of the roots turn brown. Leaves often turn yellow and red veins appear. Both weak and strong, aggressive types of fusarium have been distinguished. Weak fusarium types cause evaporation problems that cause the plant to go limp. Aggressive types result in a brown discoloration of the vascular bundles up to near the top of the plant. The base of the stem also becomes hard.

Sadly, no effective means exist to combat fungal diseases. Using chemical fungicides is not recommended, as they form a risk for the producer and the consumer, as well as the environment. One research study in Switzerland revealed that 6% of the commercial plant samples were contaminated with pesticides through improper use of chemical fungicides! Fungal diseases are often difficult to combat once they have managed to develop. That is why it is of the utmost importance to do everything to prevent or suppress these diseases. A number of measures exist that can be implemented as part of the cultivation process: Pythium types develop fastest at temperatures above 25°C. By making sure that the temperature of the room and of the nutrient solution is kept low, around 20°C, you can suppress the growth of Pythium. Make sure that the temperature does not drop below 15°C, because this will make the absorption capacity of the roots decrease too much. Fungal diseases are also unhappy in dry circumstances. This can be achieved by making sure that the atmospheric humidity does not rise too much at night and that the area between the plants is well ventilated to prevent a high degree of atmospheric humidity. So far, good hygiene has proved to be the best weapon in fighting fungal-based diseases. Mould spores can easily spread via your clothes or your skin. That is why you should avoid visiting multiple areas on one day if you suspect that they may contain diseases. Mould spores can also spread via contaminated material (such as pots that still contain traces of the mould). Make sure that the starting materials are cleaned before every crop! Diseases may also be contracted and spread from cuttings purchased. Only buy cuttings from reliable suppliers or use your own cuttings.

Temperature

A suitable temperature is important for optimum plant activity. For top results, the temperature must be at least 20°C. Temperatures above 30°C can cause problems with temperature sensitive types, certainly when this is combined with low humidity. The temperature should be between 20°C and 30°C to avoid problems.

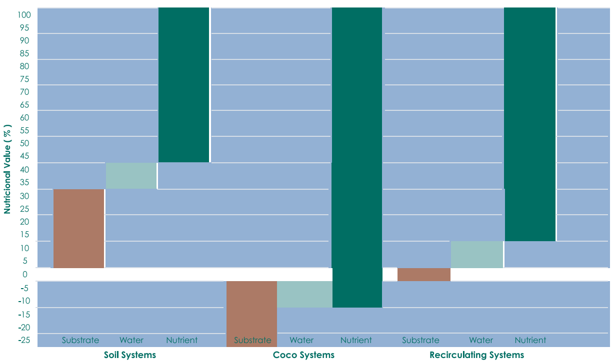
Good root development requires the temperature of the nutrient solution to be high (20-25°C). Below 15°C, the absorption capacity of the roots diminishes rapidly; the nutrient transport in the plant stagnates, reducing the yields. The growth of the plant slows and the root system will be less fine (fewer branches and fewer root hairs). The first visual sign that the temperature is too low is purple coloration of the leaf stems, main veins and stem. If the low temperatures persist for too long, leaves may also be malformed. The absorption of nitrate, phosphate, magnesium, potassium, iron and manganese is hindered most at low temperatures.

If the difference between the temperatures for the dark and light periods is too great, problems may arise immediately after the lamps are switched on. Leaves are warmed and water will start to evaporate. However, the roots are too cold to absorb sufficient water. This will make the plant hang limply and perhaps wilt. Try to prevent major differences between night and day temperatures as much as possible (no more than a few degrees difference). Maintaining an optimal root temperature is a precondition for good results. An aquarium heating element with a thermostat can be used as a cheap way to maintain the temperature.

What substrate should I use in recirculating system?

Ebb and flow systems and the drip system can be used in combination with a substrate. Most nutrient systems for recirculating systems assume that an inert substrate is used. An inert substrate is a substrate that does not withdraw nutrients from the nutrient solution, nor does it add them. This does not mean it will not affect the pH of the medium, rockwool is an example of an inert medium that does not affect the EC but does raise the pH level. A potting mix is not an inert substrate, as potting mixes contain nutrients that, if they are also in the nutrient solution, would result in an excess of certain elements. Coco has the opposite effect, withdrawing certain elements from the nutrient solution. If a recirculating nutrient is used in combination with this substrate, it will result in a nutrient deficiency. Clay, perlite and rockwool are examples of inert substrates. These substrates do not contain any nutrients, nor do they withdraw them from the nutrient solution.

The relation between Nutritional values of substrates and Nutrients



CANNA HYDRO vs. CANNA AQUA

CANNA HYDRO is a perfect nutrient that has been used successfully on recirculating systems. Now CANNA AQUA has been introduced, a nutrient that has several advantages in cultivation on recirculating systems. The pH of CANNA AQUA does not need to be adjusted during the plant's growing phase if the pH is initially set at 5.2. The pH will stay between 5.2 and 6.2. The graph on page 4 shows the convincing results of several extensive research initiatives preformed by the CANNA Research Department. Also the CANNA AQUA range have a special nutrient formulation that makes sure there will be no nutrient residues in the end product when used on recirculating systems.

CANNA AQUA NUTRIENTS

CANNA AQUA has been specially developed for use on recirculating systems, and its composition is such that the pH remains stable over prolonged periods of time. In addition, CANNA AQUA contains Silicates, humic and fulvic acids, and algae extracts that lead to an even better performance. CANNA nutrients have a biotropic effect. They are absorbed naturally by the plant's biological system and ensure the best possible balance and increased resistance in the plant's cells.

CANNA Aqua Vega

In the initial phase of growth, the basis is laid for an exuberant bloom and yield. A healthy and strong growth is characterized by vital growth spurts and excessive root development. Aqua Vega has been specially developed to meet the plant's need perfectly. Full absorption of nutrients and water penetration directly from the start of the growth are made possible by Aqua Vega's large quantities of directly absorbable, high quality, nitrogen elements, top quality EDDHA iron chelates and trace elements.

CANNA Aqua Flores

In the plant's exuberant blooming phase, it is vitally important that all necessary nutrients are available directly and in the right quantities. Aqua Flores stimulates the growth of fruits and contains all necessary elements that are required during the blooming phase. For example, the plant requires less nitrogen during the blooming phase. However, the need for potassium and phosphorous is greater. Aqua Flores is rich in these elements and special chelated trace elements allow direct absorption resulting in a perfect bloom.

CANNA ADDITIVES

CANNA AQUA allows the cultivator to include the exact quantities of nutrients in the growth and blooming phases of fast growing plants. Other CANNA products, such as RHIZOTONIC (e.g. root development, stress relief), CANNAZYM (e.g. healthy root environment) PK13-14 (e.g. stimulating flowering) and CANNABOOST (e.g. stimulating metabolism and sugar production) give additional support during various specific phases of the plant's development. Combined with these CANNA products, the plant can optimally focus on growing and blooming, guaranteeing high yields.

CANNA
The solution for growth and bloom

Cultivation tips

Keep your nutrients dark

Light breaks down iron chelates! Because of this, it is very important to ensure that no Ultra Violet light falls on the nutrient solution. As well as this, light causes algae to grow in the nutrient solution, which can lead to blockages. Further, algae can also take up nutrient elements and cause nutrient deficiencies to occur.

Rinse the Clay Pebbles

Clay Pebbles can have a high salt content. By rinsing the pebbles with water, these harmful salts can be washed away. An additional advantage of this is that dust particles are also rinsed off and these may have caused blockages.

Do not put all your money on one horse

Two pumps can be used to supply the nutrient solution to the plants to ensure that they will not be left dry if one of the two should malfunction.

Mixing nutrients

Measuring the nutrient reservoir works as follows: take EC as the starting point, measure it and determine whether is should be higher or lower, based on the values shown in the instructions. Only then should you adjust the pH using pH- or pH+, if necessary. Try to get the nutrient solution's pH value correct at the first attempt. Using too much pH- and pH+ with each other disturbs the bicarbonate concentration and the water's buffering capacity. Also, the mutual balance between the different nutrient elements will be influenced and deficiencies could arise. Adding too much pH- or pH+ can be prevented by first diluting the pH- with water before adding it to the solution.

Air and pH

If there are any air pumps in the nutrient reservoir, remember that these may raise the pH in the nutrient reservoir.

Root growth

Watch the roots closely. Otherwise they will grow into the drainage holes. This will block the drains and the system will stop circulating.

Growguide

CANNA AQUA

	Cultivation period In weeks	Light / Day In hours	Aqua Vega ml/ 10 litres	Aqua Flores ml/ 10 litres	RHIZOTONIC ml/ 10 litres	CANNAZYM ml/ 10 litres	CANNABOOST ml/ 10 litres	PK 13/14 ml/ 10 litres	EC + in mS/cm	EC Total in mS/cm
VEGETATIVE PHASE										
GROWTH: **Start / rooting (3 –5 days)** - Make the substrate wet	<1	18	15-25	-	40	-	-	-	0.7-1.1	1.1-1.5
GROWTH: **Vegetative phase I** - Plants develop in volume	0-3[1]	18	20-30	-	20	25	-	-	0.9-1.3	1.3-1.7
FLOWERING: **Vegetative phase II** - Up to growth stagnation after fructification or appearance of the formation of flowers	2-4[2]	12	25-35	-	20	25	20[5]	-	1.2-1.6	1.6-2.0
GENERATIVE PHASE										
FLOWERING: **Generative Period I** - Flowers or fruits develop in length. Growth in height achieved	2-3	12	-	30-40	5	25	20-40	-	1.4-1.8	1.8-2.2
FLOWERING: **Generative period II** - Development of the volume (breadth) of flowers or fruit	1	12	-	30-40	5	25	20-40	15	1.6-2.0	2.0-2.4
FLOWERING: **Generative Period III** - Development of the mass (weight) of flowers or fruit	2-3	12	-	20-30	5	25	20-40	-	1.0-1.4	1.4-1.8
FLOWERING: **Generative Period IV** - Flowers or fruit ripening process	1-2	10-12[3]	-	-	-	25-50[4]	20-40	-	0.0	0.4

1. This period varies depending on the species and number of plants per m2. Mother plants remain in this phase until the end (6 – 12 months).
2. The changeover from 18 to 12 hours varies depending on the variety. The rule of thumb is to change after 2 weeks.
3. Reduce hours of light if ripening goes too fast. Watch out for increasing Relative Humidity
4. Double CANNAZYM dosage to 50 ml/10 litres, if substrate is reused.
5. 20 ml/ 10 litres standard. Increase to a maximum of 40 ml/10 litres for extra flowering power.

EC: EC+ value is based in mS/cm when EC water = 0.0 by 25°C, pH 6.0.
Add the EC of the tap water that is used to the recommended EC!
The EC total in the example is with tap water with an EC of 0.4.

pH: Recommended pH is between 5.2 and 6.2.
Adding pH- can increase EC.
Use pH- grow in the vegetative phase to lower the pH
Use pH- bloom in the generative phase to lower the pH.

The guidelines in the table aren't an iron law, but can help novice growers to develop a sophisticated fertilisation strategy. The optimum fertilisation strategy is further determined by factors such as: temperature, humidity, plant species, root volume, moisture percentage in substrate, water dosage strategy, etc.

Make your personal feeding growschedule at www.canna.com

CANNA, a source of information

If this leaflet has been of use to you, you may also find the other sources of information interesting: CANNA General Brochure and the CANNA product leaflets for CANNA AQUA, CANNA RHIZOTONIC, CANNAZYM, CANNA PK 13/14 and CANNABOOST. Also available online.